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Valuing Recreational Benefits of Wonchi Crater Lake, Ethiopia

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ABSTRACT:

Wonchi Crater Lake is one of the areas famed for its natural beauty that enhances its recreational value. Its benefits range from tangible to intangible goods and services and the fulfillment of human needs. In spite of the its potential benefits, the site has been unable to expand the types of its recreational services beyond limited activities due to lack of improvement in infrastructure and lack of sustainable income from internal sources. Besides, the unsustainable practices followed by local community leads to an excessive depletion and conversion of natural resources in the area. This is accountable to the fact that the economic value of the site in terms of its recreation service to society is not well known or undervalued due to their intangibility nature, failure to properly account their values, market failure, lack of well-defined property rights leading to open access and ignorance of decision makers as to the value of natural resources. Hence, valuation of environmental resources enables economists to integrate environmental values into economic decision-making processes. Thus, the main object of this study is to estimate the recreational benefits of the Wonchi Crater Lake by using zonal travel cost method. The result of the study showed that from the Zonal Travel Cost Method, the average consumer surplus or the recreational value of Lake was found to be about 9090 birr per annum. The aggregate annual recreational benefit gained by visitors of the site was estimated to be 35,654,545 birr. The ZTCM was also used to calculate the elasticity of demand. The result for the lake was found to be more elastic, 1.57 in absolute value. The results of this study shows that the economic benefit of the lake are very higher than what is currently collected by the lake administrator. Hence, it can be suggested that they can change the current prices of its different services, alleviating the major problems that reduce the quality of the site and supporting improvement and expansion services by extracting revenue out of the excess benefit are crucial.

Keywords: Benefit, Recreational, Valuation, Wonchi Crater Lake, Zonal travel cost method

INTRODUCTION

A natural recreational resource is one of the most productive of ecosystems on world, which provide diverse tangible and intangible benefits on a sustainable basis [1].

Recreation is a human activity, which increases visitor's wellbeing. Following an increase in population, income and mobility the demand for recreation has been increasing in many developing countries. The Clawson theory revealed that putting a precise and acceptable value on recreation would be valuable in resource management and need to place values that reflect the true social costs and benefits of recreational activities [2].

Looking at in developing countries existing growth and environment tradeoffs resulted into natural resources loss and degradation. This consequently has led to the loss of associated functions and undermined their capacity to provide diversified services. The loss of natural resources attributes has serious implications on the welfare of the people whose wellbeing is directly or indirectly dependent on these attributes. One of the critical non-marketable environmental resource features has been significantly lost without much understanding of its economic value [3].

Economic value of natural resources is reflected through its linkages with economic welfare of humans and is retrieved by consumer preferences for recreational benefits. The economic valuation of natural resources is required to perform environmental accounting, natural resource damage assessment and to carry out proper pricing. Valuation of natural resources particularly in developing countries like Ethiopia is expected contribute to for the effort of the conservation measures in the existing growth environment trade-off situation [4].

Ethiopia is one of the famous countries of the world for their rich natural wetland ecosystem and its diversified and unique flora and fauna. However, the human threat has significantly increased in recent years. The catchments degradation that results soil erosion into the Lake and small seasonal streams drain into the lake with large load of silt from the surrounding farmlands is also a vital issue in this regard. This continuous silt deposition at the lake's bottom reduces the depth and results into the shrinking of the lake. Hence, one perhaps required to use the area for other development activities because of underestimation of the conservation benefits of the recreation site and overestimation of the benefits of other development activities. This is mainly due to the benefits of those valuable resources are often undervalued due to their intangibility nature and hence, it is vital to undertake recreational of the lake value to provide the information to the policy makers about the potential economic benefits of the site and include its true social costs and benefits [5].

Environmental valuation is worried with placing monetary values to natural resources. Recreation sites, as fraction and parcel of the natural resources, are resource donations of a country. Contrasting other private marketable goods, values or benefits of recreation sites cannot simply be determined through the interaction of supply and demand. Hence, there is a need to have some ways to put an economic estimate to recreation sites whose values are not easily determined in conventional market situations [6].

Economic valuation of environmental resources has made important progress in the past few years. A lot of research work has been done in many developed countries since the first attempt has been made by Clawson and Knetsch in 1966. Although natural resources are playing an important role in tourism industries and economic growth in developing countries, limited attempts have been made to estimate their economic values.

Absence of market for these resources causes disturbance, unregulated over-utilization, including water diversion for agricultural intensification, pollution and other anthropogenic interventions. Disturbance caused by human activities at the edges of a natural recreational resources hamper the breeding of natural ecosystem dependent species. This result as their economic contribution to the development of the economy under valuated. This undervaluation could lead to inefficient allocation of the resource stock, its depreciation unaccounted and uncompensated for those affected, ultimately resulting in loss of welfare to lake dependent communities and to society at large [7].

Lake Wonchi, a crater lake which lies at an altitude of about 3387m above the sea level, found 32 kilometers west of Ambo town in State of Oromia, Wonchi woreda with well-known for its beautiful mountainous landscape, used partly as farmland and partly covered by natural forest and freshness of the air and the hot spring water and other flora and fauna in the surrounding area. Even though the lake has various sources of attractions, the site has been unable to expand the types and varieties of its recreational services beyond guiding, horse renting, parking and boat renting to tourists services for a long period of time and improved infrastructure mainly because of lack of sustainable income from internal sources and the economic value of the site in terms of its recreation service to society is not known [8].

Generally, the reviewed empirical works in Ethiopia showed that the existing research on the benefits associated with recreation area has largely been limited to either the estimation of a recreational benefit using the individual travel cost method or to the value associated with improvements to the recreational resource using the contingent valuation method or to a combination of the two or the Choice Experiment methods. Additionally , the existing research is mostly restricted to measuring the recreational net benefit of the multiple individual visits rather for infrequently(isolated) visited sites and hence this study is expected to address this knowledge gap by using Zonal travel cost that have not received much attention in the literature in general and in Ethiopia in particular.

To the best knowledge of the researcher, there is no attempt has been made in Ethiopia to impute economic values of recreational of a natural resources with a zonal travel cost method as environmental valuation techniques. Hence, this is the first rigorous attempt to estimate economic value of a recreational wetland ecosystem in Ethiopia in general and Wonchi Crater Lake in particular.

As a result, this study used travel cost method of environmental valuation attempted to determine the economic value of Lake Wonchi and it could also be used as an input for comprehensive and rigorous policy oriented to reduce the paucity of research work on the area of environmental economics.

RESEARCH METHODOLOGY

This study was undertaken in State of Oromia in South West Shewa Zone, Wonchi woreda[1], it is situated at the major topographic feature in the country, being 155 km west of Addis Ababa and 32 km west of Ambo. Wonchi Creator Lake[2] is a naturally gifted crater lake on a mountain which is situated on a plateau 3387 meters high above sea level and is 560 hectares wide, with depth ranging from 9 to 67.8 meters, ecologically, recreationally, and aesthetically important as well as a popular place for tourists. The lake is located in Western Shoa zone, which extends between latitude 15^0 N -3^0 S and longitudes 48^0 E-33^0 W. It is surrounded by Kelela region in the north, Dera region in the east, Goro Wonchi region in the south and Haro Gebeya region in the west. Tourism activity is a very little to the site and industrial activity is very low in this area, and it can be said that it does not present any significant threat to the environment, yet.

The area is famed for its beautiful mountainous landscape, used partly as farmland and partly covered by natural forest and freshness of the air. An old monastery with a church is situated on one of the lake islands called Cherkos monastery an island that is the home of Wonchi Chirkos, a 13-15th century monastery. Other attractions included the hot mineral springs, waterfalls and dramatic valleys around the lake, maintaining trekking and site seeing and petrified wood at the lakes bottom. At Southwest of the lake, there is a several lukewarm springs. These hot springs are frequented by many people, as they are believed to have healing powers. Surrounding this site, there are a bountiful wildlife including colobus monkeys, apes, bushbuck, gazelles and others (they are normally hidden between the trees and bushes), there are also plenty beautiful aquatic and terrestrial birds and foliage, the indigenous forest and alpine vegetation.

The some part of money obtained from entrance fee is goes to the community fund that proceeds contribute to improvements of the social infrastructure, such as village schools rather than for the conservation of natural resources and its shores and improve additional services for the visitors.

A large number of surrounding communities benefit from Wonchi natural resources. Water related benefit people obtain includes provision of fresh water for drinking, household and livestock use, improvements of the social infrastructure, such as village schools, fuel wood, it also provide food for local communities in the form of fish and has socio-economic value attached to it and the ecosystem as a whole provide nature-based recreation service to a wide range of users from local visitors to international tourists.

The study used zonal travel cost approach to estimate the visitors demand and the successive use value of visitor's benefits of Lake Wonchi. Both primary and secondary data were used for this study. The primary data was collected through visitor's survey using face-to-face interviews during the year 2013. Secondary data on the population of different regions from where the tourists visited the selected site was also taken from the figures published by the CSA in 2013 and used to calculate the number of people residing inside the zones. Other supplementary secondary sources also collected from Wonchi woreda tourism and cultural office and Wonchi ecotourism association office.

With the Zonal Travel Cost (ZTCM) approach, secondary visitation data was used with population data to estimate visitation rates by zone. The political division of Ethiopia into states was used for the definition of distinct geographic zones. The field survey was implemented from May 8- May 29, 2013,

[1] Woreda is an Ethiopian administrative unit equivalent to a district. Wonchi woreda is a popular tourist destination a two hour's drive from Addis Ababa, renowned for its beautiful Crater Lake.

[2]You can see the picture and topographical location of Lake Wonchi in **figure 2&3** respectively.

the first to third week of May over twenty one days, to account for variations in the composition of visitors on weekdays and weekends. The interview method for this travel cost was based on face-to-face (in-person) interview to the visitors. Interviewers were supervised by the author. A sample of visitors was taken during peak season, which can be considered as representative of the total visits undertaken in one year. In the case of Wonchi Creator Lake, the peak season of visit is May when 502 visits were undertaken only in May 2012. The total number of monthly visitors of the site for the previous year was obtained from annual report of the WETA. Then, a sample of visitors was taken during peak season (when there is a large number of visitors), which can be considered as representative of the total visits undertaken in one year. This time of year represents an average season in terms of the number of visitors.

The sampling technique implemented during the onsite survey was the random sampling. The group visitors of each group were randomly selected and interviewed on-site using structured questionnaire. The structured questionnaires were developed and distributed to the sub-sampled respondents. The questionnaire was prepared for on- site visitors which helped to estimate the use value of the site using Zonal Travel cost method. This survey questionnaire was collected the relevant information about: the origin of the visitors, mode of transportation used, travel expenses (for transportation, lodging, equipment rental, and guidance services, boating from all zones a miscellaneous expenses at the site), time spent at the recreational site (time spent for the trip measured in hour) and other data required for the travel cost analysis. Additionally, random sampling of the groups' visitors was done throughout the day to capture variations in the origin of visitors at different times of the day.

Given time and financial constraints, minimize exposure to small sample bias; this study was limited to 238 sample visitors coming from different areas of the country. Nonetheless, the survey produced (collected) information from 95 sub-visitors, as single questionnaires were used to interview groups with, one leader member and one earning member from each group. The basis for doing this is that for all samples, all the individuals in the data set have similar characteristics in travel costs but opportunity cost of time and socioeconomic characteristics[3] varies a lot for different individuals.

The travel cost data was collected using a zonal travel cost method and the ordinary least square method was used for analyzing the data. The result was estimated using Stata version 11.0 and Limdep, NLOGIT 3.0.

Model specification

The economic valuation of recreation benefit based on Clawson's method of zonal travel cost approach for this study is determined as follows. The quantity purchased of any good is a function of its price as economic theory suggests. Similarly, to a recreation demand curve can be established using observations on visitation (i.e., demand) and expenses incurred during visits (i.e., the price of the experience). Theoretically, visitation is a function of total travel costs, such that:

$$V_{ij} = f(TC_{ij}) \quad \text{---------- (1)}$$

Where V_{ij} is the number of visits per zone *i* to site *j* and TC_{ij} is the average total travel cost from zone *i* to the recreational site *j*.

The zonal TCM divides the visitation observations into zones based data obtained from current visitors and uses the population within each zone as the measure of visitation to the site. Zonal visit rates (the participation rate of zone *i* (visits per capita to the site *j*)) are calculated as follows:

$$VR_{ij} = \frac{V_{ij}}{N_{ij}} \quad \text{---------- (2)}$$

Where V_{ij} is the total number of visitors from zone *i* to site *j* as obtained from the survey study N_{ij} is the population of zone *i*, the CSA, [11] reports.

[3] It is thus intuitive to ignore socio-economic variables from regression analysis. Aside from the total travel costs variable, the inclusion of the other variables in the regression model did not yield significant results and thus were dropped in the model.

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Given that the zonal TCM uses visitation rates as a proxy for quantity purchased and travel cost as a proxy for price, the following visit demand function is estimated:

Demand function

$$Ln(VR_{ij}) = \alpha + \beta TC_{ij} + u_{ij} \text{ ---------- (3)}$$

Where α and β are the intercept and slope of the demand curve, respectively, and u_{ij} the error term follows a normal distribution.

Where V_{ij} the number of visitors and TC_{ij} are the travel costs

Then, the aggregate demand curve is:

$$Qd = \sum_{i=1}^{7} N_i \bullet VR_i = \sum_{i=1}^{7} N_i \bullet f(TC_i) \text{ ----(4)}$$

Where N_i is the Population of zone i^{th} , V_{ij} represent the scaled number of visits per 1000 population from each zone for the month. TC_{ij} , the actual cost for visitors from zone i^{th}

From equation (3 &4) we have aggregated demand function for log-linear functional form as follows:

$$Qd = \sum_{i=1}^{7} \left(\frac{N_i}{1000}\right) * (e^{\alpha+\beta TC_i}) \text{ ---------- (5)}$$

The final step is to estimate the total economic benefit of the site to visitors by calculating the consumer surplus, or the area under the demand curve. This results in a total estimate of economic benefits from recreational uses of the site. Having estimated the aggregate demand curve, it can be used to estimate two types of benefits.

i. Consumer surplus

The economic benefits of Lake Wonchi can then be estimated by quantifying the area under the demand curve and above the price paid for purchase of the recreation, also known as the consumer surplus (CS). The economic benefit to individuals is often measured by consumer surplus (what they are willing to pay over and above what they are already). For the ZTCM, this measure can be shown as follows:

This study closely follows the step in Morris [9] and Siti [10] to the estimation of consumer surplus for the semi-log functional form of ZTC as follows. This thesis uses number of visits (VR) and total cost (TC), instead of quantity and price as in Morris:

From equation (3) we have:

$$VR = e^{\alpha+\beta TC} \text{ ---------- (6)}$$

An incremental change in consumer surplus (CS) due to a change in total cost for a given quantity of visits can be shown as:

$$dCS = VR \bullet dTC \text{ ---------- (7)}$$

Integrating equation (7) gives CS as follows:

$$CS = \int dCS = \int_{TCi}^{TC_{\max}} VR \, \mathrm{dTC} \text{ ---------- (8)}$$

The upper limit of integration is the choke price or cut-off total costs, where a visit equals to zero. *TC* max = a choke price, possibly ∞. The lower limit of integration defines the lower boundary of the CS area. Substituting equation (6) into equation (8) we have:

$$CS = \int_{TCi}^{TC_{\max}} e^{\alpha+\beta TC} \, \mathrm{dTC} \text{ ---------- (9)}$$

$$CS = e^{\alpha} * \int_{TCi}^{TC_{\max}} e^{\beta TC} \, dTC = \frac{1}{\beta} e^{\alpha+\beta TC} \Big|_{TCi}^{TC_{\max}} \text{ -(10)}$$

Assessing equation (10) at both limits of integration in results as:

$$CS = \left(\frac{1}{\beta} e^{\alpha+\beta TC_{\max}}\right) - \left(\frac{1}{\beta} e^{\alpha+\beta TC_i}\right) \text{ ----------}$$

(11)

As the upper limit goes to infinity for $\beta < 0$: $\lim_{TC_{\max} \to \infty} e^{\alpha+\beta TC_{\max}} = 0$, then from equation (11) we have:

$$CS = -\frac{1}{\beta}(e^{\alpha+\beta TC_i}) \text{ ---------- (12)}$$

Inserting equation (6) in equation (12) gives:

$$CS = -\frac{1}{\beta}(e^{\alpha+\beta TC_i}) = -\frac{1}{\beta} * VR \text{ ---------- (13)}$$

Hence, the average consumer surplus per trip can be calculated as:

$$ACS = \frac{CS}{VR} = \frac{-VR}{\beta * VR} = -\frac{1}{\beta} > 0, \text{since } \beta < 0 \text{ --}$$

---------- (14)

Where CS_{ij} measures the surplus value (i.e., wealth) that the visitor's i^{th} receives from visiting Wonchi Crater Lake. The sum of visitor's consumer surpluses, therefore, is a measure of the surplus value that society receives from access to the economic benefits Wonchi Creator Lake.

ii. **Expected Revenue**

Total cost method helps predict expected revenues at different levels of gate fee.

$$ER = P * VR_{ij} * N_{ij} \text{ ---------- (15)}$$

Where ER is expected revenue, VR_{ij} is the participation rate of zone *i*, N_{ij} population of zone *i* and *p* is gate fee. This is very important in helping lakes administration officials decide at what level to set entry fee and how well they can cover their costs.

Based on F and t-tests, adjusted R^2 values, and consideration of autocorrelation and heteroskedasticity problems this paper used log linear functional form because it minimizing the problems of heteroskedasticity and gives efficient and consistent estimates and, as well as eliminating the potential problem of negative trip prediction which can occur using a other functional forms [11].

$$\ln(V_{ij}) = \alpha + \beta TC_{ij} + u_{ij} \text{ ----------} \quad (16)$$

RESULTS AND DISCUSSION

Descriptive Analysis

Geographical Characteristics of the visitors

The TCM requires information about the visitors to a site. This information was collected by conducting an on-site survey of visitors to the lake Wonchi. The survey questionnaire asked about origin of the visitors, mode of transportation used, travel expenses, miscellaneous expenses at the site (tent), time spent for trip, socio-economic characteristics of some sample visitors and other data required for the travel cost analysis. Using this method, seven zones[4]were determined and named as zone A, zone B, zone C, zone D, zone E, zone F and zone G as shown in **table 4.** Of the total respondents, 21(22.11%) respondents interviewed in the site were from Addis Ababa (zone-A), 12 (12.63%) respondents were from Gindo (zone-C),11 respondents interviewed (11.59 %) were from Ambo (zone -B), 9 (9.47%) respondents were from Cittu (zone-D), 7 (12.63) respondents were from Sebeta (zone-E), 12(12.63%) respondents were from Wolkite (zone-G), 30 (31.58%) respondents were from Woliso (zone-F). The largest number of visitors, 89 (37.40 %) were from Addis Ababa (zone -A), followed by 65 (27.31%), 25(10.50%), 22 (9.24), 16(6.72%), 12(5.04%), and 9(3.78%) from Woliso, Sebeta, Ambo, Wolkite, Gindo and Cittu respectively.

The figures published by the CSA in 2013 were used to calculate the number of people residing inside the zones. Besides, the visitors who had no previous decision to visit the lake were excluded in the calculation of the lake visitors. All of the visitors said that their visitation rate is one; this is consistent with zonal travel cost. All the group of visitors said that the aims of their visit were not related to any business. The entire economic benefit of the lake Wonchi was gained as the sum of the calculated costs belonging to the seven zones. Distances have been taken from the mid-point of the districts concerned to the mid-point of Haro wonchi district which is available at Road and Transportation Authority of Ethiopia or elsewhere[5].

Distance of visitors

The relationship between the number of visitors and their distance to the lake is reported in **table 4**. Results in the table revealed that number of people have been visited the lake during study period from different areas of the country. Of total, 37.40% of visitors inhabit from 155 km farthest of the lake and also, people living in zone's "A" are the major portion of the visitors whereas the "D" zone's is the nearest to the site as well form the minimum portions the visitors, which accounts 3.78% (see **table 4**).

Socio economic and demographic factors

Table 1 shows that descriptive statistics for sub-sample though descriptive statistics are not presented for all sample. We assumed that the respondent from a group was considered as representative of the whole group, in all of aspects of travel cost except travel time cost. The basis for doing this is that for all samples, all the individuals in the data set have similar characteristics in travel costs but opportunity cost of time and socioeconomic characteristics varies a lot for different individuals. The sample size for the visits sub-sample is small; it means that this sample cannot use in the regression analysis however the

[4] Addis Ababa is the capital city of Ethiopia; Cittu is the town of Wonchi woreda, which is one of the 180 woredas in the Oromia region of Ethiopia part of West Shoa Zone and bordered on the east west by Amaya, 0n the east west by Ambo, on the north east by Dandi and South east by Woliso; Gindo is the town of Amaya woreda, one of the Woredas in the Oromia region of Ethiopia part of the North West Shoa zone; Ambo town is located in the west Shoa zone of Oromia region, west of Addis Ababa; Sebeta town is one of special zone of Oromia region; Wolkite is a town and separate woreda in South Eastern Ethiopia, the administrative center of the Gurage.

[5] Road and transportation services of Woliso town

descriptive statistics might provide important indication for policy recommendations.

In the questionnaire, there was a question asking visitors if they are employer, non employer and leader of the group. Based on this question, it was easy to come up with separate data sets for either employer or leader and others and hence, calculate opportunity cost of time based on the assumption made for income group whereas for non income group the cost of time was considered to be zero. Out of number total interviewed sub sampled visitors, ninety one are income groups and four are from non income group, a leader member. The other sampled visitors who are not interviewers are neither a leader nor employer. The socio economic and demographic factors for these sub-samples are presented in **table 1**.

As it revealed in **table 1** this study was collected of data from sub- sample of 95 visitors coming from different areas of the country. Out of the total visitors sub-sampled, males are 67 and females are 28 comprising 70.53% and 29.47% respectively. 41.05% of the sub visitors have reported to be married and 58.95% are unmarried. Moreover, the mean age of the respondents was 30.47368 years old. The mean years of education were 15 years. The average income of sub-visitors was 2479.621per month.

Mode of transports

As revealed in **table 2**, of total visitors, 89.92 % of the visitors have visited the lake through renting vehicles, 4.2% using their own private vehicles and 5.88% visitors used public vehicles. As shown in the **table 3** all sample visitors were traveling in-group during the survey period. Total numbers of groups are 17. The average number of persons in a group was 14.

Total expenditure for trip

Travel cost is the average cost of getting the site and travel time to the site for each zone. People in Zone "A" will have the highest travel cost, while zone "D" will have the lowest travel costs. In order to determine the lake's economic value for those visitor's come by public vehicles they were directly asked to state exactly the amount they have spent to get the lake and for those renting total cost of renting were asked the respondents in order to get the site, which are implicitly determined supposed to include petrol price and cars wear and tear ,this to represent the marginal costs of travel and for visitors using their own cars travel cost was calculated to be the two-way distance traveled divided by the fuel economy[6] (L/100km) of the vehicle multiplied by the cost of gasoline. During the study period the cost of petrol was 17.50 birr per liters. Here petrol consumption is assumed to be equal to 13 liters per 100 km on average. The study also assumed average speed of driving for all cars (50 km/per hour) to lake. This figure is taken from the cost the government pays to government servants for their traveling expenses which are supposed to include petrol and cars wear and tear.

$$TTC = CTL + ENF + CBOT + CHOR + GUID + OPCT + EXPFB + PAC + TENT;$$

$$OPCT = \frac{1}{4} \bullet DI_{i\ perday} \bullet days, for\ job\ holders\ (either\ the\ private\ or\ public\ sectors) - - - (a)$$

Where *TTC* is total travel cost, DI is the per day disposable income for employers, days is the number of days spent, CTL represent the transport cost for lake Wonchi (either for own or public or/and rent), *ENF* is the entrance fee for the lake in birr, *CBOT* is boating fee either for single or round trip, *CHOR* is the cost of hiring horse for either go or back or both, *GUID* is guiding fee, *EXPFB*[7] is expenditure for food and beverage as a result of trip, *PAC* is outlet for the parking of the car, *TENT* is the cost for renting if they stay at night time also, OPCT is the opportunity costs in birr of travel time per trip.

To calculate the opportunity cost of travel time, the researcher considers many things into consideration. For students, retired workers and unemployed, their opportunity cost of travel time was considered to be zero as consistent the study of Amoako-Tuffour; Martinez-Espineira, [13] and Timah Paul [14]. This is because this group of visitors will otherwise not undertake any paid job if they decide not to visit the lake as an alternative [15]. Their alternatives will mostly be unproductive ventures such as playing soccer, visiting friends, searching for jobs or studying. Such alternatives could not be valued in

[6] Economy of fuel (fuel efficiency) is the ability to make the best use of the fuel being used. It is calculated based on distance (kilometers) and fuel used (liters) using scientific calculator.

[7] Although the person would also consume at home, yet some extra expenditure on food and beverage is incurred during the trip and that has actually been considered here.

monetary terms in this study. The above assumptions are reasonably justifiable in a country like Ethiopia. This is so because not often will you get students taking part time jobs besides their studies due to a huge unemployment that is inherent in the country.

For the visitors surveyed employments' who are employed either in private or public thus had a fixed income. For visitors who are employed, their opportunity cost of travel time is considered to be 25% (0.25) of their estimated hourly or daily wage rate as (the 25% rate used by Zawacki *and others* [16] as many visitors have chosen to visit the area during their leisure time, this study takes the lower bound, which is one fourth of the wage rate, as an opportunity cost of time for job holders as shown above. In estimating the average hourly wage rate of visitors, this thesis assumed that a 40 hours' work week which is typical of the Ethiopian economy. This gives approximately 8 hours a day and a 5 day work per week. The visitor's monthly income is then divided by this number to obtain the average daily wage rate. This is then multiplied by the reported travel time of the visitor by 25% (0.25). The onsite expenses are as reported in the questionnaires. The total travel cost (TTC) is then obtained by summing the travel cost, onsite expenses and cost of travel time. TC per person can be obtained by dividing total travel costs by number of persons in the group[8]. The calculation of the travel costs based on the above explained approaches give the impression of appropriate as it is based on information directly stated by visitors.

The visitation rate for a zonal travel cost analysis is the rate of visitation from each determined zones to the study site. Naturally, the further away a zone, the higher the average travel costs for visitors and hence, the fewer visitors. Under convinced assumptions, travel costs are a surrogate market on which it is possible to observe a negative relationship between costs of visit and rate of visits per zone, enabling the estimation of a demand curve [17].

[8]It is assumed children do not contribute to paying costs and therefore represent an additional cost burden to the adults in the group.

Econometrics Analysis

Even though the linear functional form of OLS regression allows the possibility of negative visitors, implies finite visitors at zero cost but has a critical cost above which the model predicts that negative visitors will be demanded, logarithmic forms have the advantage that they may be more easily used to calculate demand elasticity's. The double-log functional form implies infinite visitors per head at zero cost. The log linear, or semi-log dependent functional form of OLS, is widely used in TCM studies. It implies a finite number of visitors at zero cost and never predicts negative visitors even at very high costs. As a matter of fact, in a Monte Carlo study Griliches and Rao found that if the sample is relatively small and the coefficient of autocorrelation, ρ, is less than 0.3, OLS is as good as or better than FGLS. As a practical matter, then, one may use OLS in small samples in which the estimated rho is, say, less than 0.3. [18].This study was supported by this argument, since in our OLS regression, the coefficient of autocorrelation, rho is less than 0.3 for all functional forms (**see table 5**) and our sample size is relatively small due to the nature of zonal travel cost method. Thus using OLS regression is justified.

In this study the simpler zonal travel cost that includes only travel cost and visitation rates, i.e., visitation rate= (Constant) - (Coefficient)*(Travel Cost) has been used to estimate the economic benefit a one-time visiting. The only independent variable used in this study is the travel cost as in line with the study carried by Lansdell and Gangadharan [19]; [20], study that includes only travel cost as their independent variable. The relationship between average zonal travel costs and zonal visitation rates can be estimated using OLS regression. To get the trip generating function, the zonal visitation rate was regressed against average zonal travel cost.

The functional forms that are presented here are linear-log, log-linear and double log forms; for other forms do not give better results than these forms. Based on using F-test, adjusted R^2 values, and consideration of autocorrelation and heteroskedasticity problems; this paper used log linear for further analysis because the log linear, or semi-log dependent functional form, implies a finite number of visitors at zero cost and never predicts negative visitors even at very high costs and further it is the best fit of our model than other functional forms as shown in table 5 (model C). Hence, this

study chosen log-linear functional forms, model C (log-linear) for further analysis.

1.1 Measures of Goodness of Fit of model

The best fitting functional form for the estimated demand function turned out to be log lin. Adjusted R^2 which is approximately 56% is a higher compared to the other model as explained in above table. Our explanatory variable explains about 56.43 % of the variation in explained variable.

The travel cost coefficients have registered the expected signs, negative sign, and is highly significant at 1 per cent significance level for both model B and C while model A significant at 5% significance level. The travel cost coefficients are consistent with the demand theory, which stipulates that when the price of travel increases then the number of visitors will decrease. The negative sign is expected because as the costs of travel to the site increase, the number of visitors is expected to decrease, ceteris paribus (given a fixed level of income). A one birr increase in travel costs will decrease the number of visitors by .011 percentages, ceteris paribus. Or .011is a percentage change in visitation for a given absolute change in the value of the travel costs.

Demand function

The estimated demand function for our model is:

$$LN(VR_i) = 1.05177 - 0.00011(\mathrm{TC}_i) \text{ --------- (b)}$$

Then, the aggregate demand curve is:

$$Qd = \sum_{i=1}^{7} N_i \bullet VR_i = \sum_{i=1}^{7} N_i \bullet f(TC_i) \text{ ---- (c)}$$

Where N_i the Population of zone is is i^{th}, VR_i represent the scaled number of visits per 1000 population from each zone for the month, TC_i are the actual costs for visits from zone i^{th}.

From equation (2) we have aggregated demand function for model C (log-linear functional form) as follows:

$$Qd = \sum_{i=1}^{7} \left(\frac{N_i}{1000}\right) * (e^{\alpha+\beta TC_i}) \text{ ---------- (d)}$$

By substituting the result of our model into equation (3) we obtain the aggregate demand function for log-linear functional form as follows:

$$Qd = \sum_{i=1}^{7} \left(\frac{N_i}{1000}\right) * (e^{(1.05177-0.00011\ (TC_i+p_i))}) \text{ - (e)}$$

Where p (entrance fee) is hypothetical increases in the travel costs to predict how the number of visitors from zone i would react to increasing entry fees (costs-increases,) Qd is equal to number of visitors.

The next is to construct the demand function for visits to the site, using the results of the regression analysis. The first point on the demand curve is the total visitors to the site at current access costs (assuming there is no entry fee for the site) i.e. substituting in current average zonal travel cost and multiplying by scaled zonal population; this model yields an estimated number of monthly visits of 301. The other points are found by estimating the number of visitors with different hypothetical entrance fees (assuming that an entrance fee is viewed in the same way as travel costs). We start by assuming a birr 10 entrance fee. Plugging this into the estimated regression equation, $VR = e^{(1.05177-0.00011\ (TC+p))}$ and multiplying by scaled zonal population from each zone gives the following:

The above points give the demand curve for trips to the site as shown in **figure 1**.

Consumer Surplus

By using the log-linear model, average consumer surplus can be calculated as below $(ACS = -\frac{1}{\beta} > 0, \text{since } \beta < 0)$ (details are in Chapter 3). Hence, by using the log-linear functional form, we can easily estimate the average consumer surplus, that is, one over the parameter estimate of travel cost. Anex [21] and English and Bowker [22] and Siti [23] also used the log-linear functional form to calculate the average consumer surplus. With that, we obtained the average consumer surplus per trip per1000 populations from the seven zones for Lake Wonchi is 9090.909 birr. By using equation (13) under model specification, all the zonal answers were added to obtain the estimate of total consumer surplus. This yielded a surplus (the recreational value for the average visits for OLS model) of 61,720.42 birr per month, which converts to 205 birr per-person per-visit which is a sensible value. Then aggregate average consumer surplus is obtained by multiplying average consumer surplus of the visitors by the total number of 3,922 visits for the last 12 months before the survey is under taken, which is approximated to 35,654,545 birr. Thus, the study concluded that the annual on-site recreational benefit (recreational value) of Lake Wonchi was estimated to be 35,654,545 birr per year but the site authorities

collect only 374,301 birr per year, from entrance fees to finance its expenses and salaries for employees of the site. This indicating that much can be done to generate revenue for the support of quality improvement and expansion projects at the site and the site is not used effectively. Furthermore, it can be conclude that it is worthwhile to spend money on programs and actions to protect this site.

The price (total travel cost) elasticity is approximately equal to 1.6 in absolute value. This elasticity is measured at the mean values of independent variable namely, $\overline{TC}$ which is 14653.77. This study finds that the price elasticity[9] for visitors are relatively elastic and has negative sign and highly significant and it was -1.567018 (**see table 7**). This finding is consistent with study of Lindberg and Aylward [24] hypothesized that price elasticity's for local visitors are more elastic. As a result of, local visitors affected by price increases, as locals may have lower income (and thus be price sensitive), as well as be more aware of potential substitutes. In order to predict how visitation rate from zone i would react to the hypothetical entrance fee increases in the travel costs, we used that the actual variations in price (gate fee) and quantity demanded (visits) at each price. After different types of models are compared ordinary least squares, with log-linear[10] form for it has a higher R^2 was used for calculate elasticity at seven prices: 10birr, 20 birr, 30birr, 40birr, 50birr, 60 birr and 70birr. The estimated elasticity for the lake at all seven prices respectively as: -1.568087, -1.569157, -1.570226 , -1.571295 , -1.572365 , -1.573434 and -1.574504. The difference between estimated elasticity for the lake at all seven prices is less than 0.002 in absolute value for both functional forms.

[9] We can calculate the elasticity for log-linear and log-log functional forms by using the following formulas as:

[10] Elasticity for log-lin= $\beta(TC)^*$

Elasticity for log-linear= β a model in which the regressand is logarithmic will be called a log-lin model. Semi log models because only one variable (in this case the regressand) appears in the logarithmic form.

* indicates that the elasticity is variable, depending on the value taken by *TC*. When no *TC* values are specified, in practice, very often these elasticity are measured at the mean values of these variables, namely, $\overline{TC}$ which is 14653.77

Therefore, it can be concluded that the effect of increasing entry fees is not going to vary much, i.e., although demand for the lake is slightly more elastic as we have seen, there is no significant difference between the elasticity of the visits at all seven entrance fee. Even though demand for the lake is slightly more elastic, the difference between the increments in entrance fee is insignificant because entrance fee cover small proportion of travel cost, it can be conclude that the elasticity is approximately equal 1.6 in absolute value. This is why the (optimum) entrance fee is determined at 50 birr for local visitors; here foreign visitors are beyond this study.

Expected Revenue

Based on the entrance fee we determined, we calculate expected revenue as follows $ER = p * VR_{ij} * N_{ij}$ Where ER is expected revenue, VR_{ij} is visits per capita to site j, N_{ij} population of zone *i* and p is gate fee. This is very important in helping lakes administration officials decide at what level to set entry fee and how well they can cover their costs.

The study indicated that the optimal gate fee is Birr 50 for local visitors and the maximum expected revenue for the site is 58,633,900 birr (=50*299*3922) where 3922 is the number of total Visits per year. Thus, we conclude that the expected revenue at 50 gate fee is 58,633,900 birr per year.

CONCLUSION AND RECOMMENDATION

The theme of this study was to give a quantitative estimate for current recreational use values of Lake Wonchi so as to help planners and decision makers rising in the input from economic valuation by presenting a sound valuation technique and process to accept the best feasible approach towards a sustainable improved conservation. In doing so, the study applied zonal travel cost. The zonal travel cost methods was used to estimate the economic benefit of the recreational and it depends on information about the amount of money and time visitors spend for recreational aim of that site. The total travel costs which is the sum of travel cost per round trip and a travel time cost, is used to estimate the economic benefit associated with the site based on OLS model.

The results of the zonal travel cost method showed that travel cost is important determinant of the recreation demand of the site. The recreational benefit computed from the regression analysis

showed that the average consumer surplus per trip per1000 populations from the seven zones to Lake was estimated to be 9090.909 birr. This amount was translated into an expected aggregate annual benefit of birr 35,654,545 which shows that the value of the benefit that visitors gained by visiting recreational site. Although the site has a much larger economic potential than was actually exploited, this study showed that very few percent of the potential recreational economic benefit of the site. This recreation use value of the site mainly refers to domestic users. Consequently, the true recreational use value of the site is believed to be higher than the reported figure if excluded recreation benefit to foreign visitors is considered. These findings are quite consistent with the findings of other similar works

The optimum entrance fee was determined and it would be used as a gauge to determining the revenue sources of the administrator and improve the Lake quality. Further, another finding from the ZTCM shows that the price elasticity of demand for lake is 1.57 in absolute values for local visitors may be more affected by price increases, as locals may have lower income and hence price sensitive, as well as more aware of potential substitutes. However, the effect of an increase in gate fees will not vary much among different hypothetical entrance fee. i.e., the price (entrance fee) elasticity of demand does not vary much among different gate fees.

Based on the findings of this study, the following recommendations can be presented:

- As previously discussed, the manager in Wonchi Crater Lake, stands to benefit a lot from the result of this study if they come to a decision to implement a gate fee. Hence, it is recommended that a thorough cost benefit analysis of such a project should be conducted.
- The results of the survey showed that responsiveness of the visitors towards change in entrance fee is inelastic. This result has important impression in that if the site authority change the current level of entrance fee and raise additional money, there would be a higher income to support improvement and expansion of the types and varieties of recreational services.
- Moreover, the WETA manager should raise the current price of different services offered in the site based on the estimated average consumer surplus as a guide on the fee structure. This allows the site managers to have a higher income to sustain improved conservation and expansion of the types, infrastructure and quality of the recreational services.
- An important suggestion that were made by sub-sample of the visitors regarding the quality and services of the lake and what could be done to improve the quality and services of the lake, include the provision of public chair at the creator, restaurant or cafeteria or hotels and sporting infrastructures which could be bought or rented by visitors such as personal flotation jackets, train boats and other sporting equipments, showers. Besides, some visitors were apprehensive with sanitary situation of the creator. It noted that based on the researcher's own observations, these concerns and suggestions are reasonably true. Consequently, the local government, manager, local community should immediately solve these problems so as to increase the existing recreational demand to the site. For this rationale, the site authorities can use portion of the changed entrance fee. Failure to solve these problems may oblige visitors to shift their interest to other substitute sites. This may lead to ultimate shut down of the recreation site.
- This findings are not only vital to the managers but similarly to potential private investors who are looking to invest in the related area of environmental resources such as natural wetland ecosystems, and also in the lodge and tourism industries in Wonchi or somewhere else in Ethiopia.

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Declaration

The authors declare that this manuscript is not submitted to any other journals, and it is submitted to

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Table 1: The socio economic and demographic factors of sub-samples

Variable	Obs.	Mean	Std Ded.	Min	Max	Variable		No. respondent	Percent
Age	95	30.48	7.59177	20	56	Gender	Female	28	29.47
Income	95	2479	769.986	0	5000		Male	67	70.53
Sex	95	.7052	.4583431	0	1	Marital	Married	39	41.05
Education	95	15.316	.8260864	12	17		Unmarried	56	58.95
Marital	95	.3784	.4876986	0	1				

Source: survey results, 2013

Table 2: Number of visitors in the group and their mode of transport

Mode of transports	Number groups	No. of visitors	Percent
Rent	11	214	89.92
Public	4	14	5.88
Own	2	10	4.2
Total	17	238	100

Source: survey results, 2013

Table 3: Number of visitors in a group

Number of visitors in a group	Frequency	Total Number of visitors	Percent
2	1	2	0.840
4	3	12	5.042
5	2	10	4.202
12	2	24	10.084
15	1	15	6.303
16	1	16	6.723
19	1	19	7.983
20	2	40	16.807
25	4	100	42.017
Total	17	238	100

Source: survey results, 2013

Table 4: Data compiled for zones

Zones	Towns include in the zone	Distance from the site(km)	Population(units of thousands)	Number of sampled Visits (VA)	Visitation rate = (VA /P)	VR=(1000)* (VA /P)	Travel Cost (birr)
A	Addis Ababa	155	3,103,700	89	2.86755E-05	0.028675	40018.94
B	Ambo	32	61,900	22	0.000355412	0.355412	11248.11
C	Gindo	50	5,228	12	0.002295333	2.295333	6873.75
D	Cittu	29	1574	9	0.005717916	5.717916	2637.625
E	Sebeta	130	63,400	25	0.000394322	0.39432177	13987.38
F	Woliso	37	48,700	65	0.001334702	1.334702	21269.36

G	Wolkite	79	41,500	16	0.000385542	0.385542	6541.25

Source: own survey results, 2013 and 2013 report by CSA

Table 5: Zonal TCM using lin-log, Log-Log (double log) and log-lin Model

Models	Dependent Variable	Constant (standard errors) (P-value)	Coefficient (standard errors) (P-value)	Adj R-squared	F-statistics (p-value)	Durbin-Watson Stat. (Rho)
A	VR	17.5742449 (6.1439378)** (0.0354)	-1.73262257Ln(TC) (.63705535)** (0.0418)	.4920173	6.81 (.0477)**	2.4644198 (-.2322099)
B	Ln(VR)	13.6087919 (3.727318)*** (.0147)	-1.52257308Ln(TC) (.42264096)*** (0.0155)	.5484431	8.29 (.0346) **	2.2243250 (-.1121625)
C	Ln(VR)	1.05177424 (.52877)* (.0942)	-.00010694TC (0.000216702)*** (.0043)	.5642771	9.07 (.0297)**	2.4365942 (-.2182971)

***, ** and * indicates at 1%, 5% and 10% level of significance respectively

Sources: own computation, 2013

Table 6: The relationship between hypothetical incremental in entrance fee and total visits

	Log-lin (model C)
Entrance fee (p)	Total visits per month
0	300.8619
10	300.5403
20	300.219
30	299.8982
40	299.5776
50	299.2575
60	298.9376
70	298.6181

Sources: own computation, 2013

Table 7: The price (total travel cost) elasticity

	dy/ex	Std. Err.	Z	P>|z|	[95% Conf. Interval]	
TC	-1.567018	.3757304	-4.17	0.000	-2.303437	-.8306003

Source: own computation, 2013

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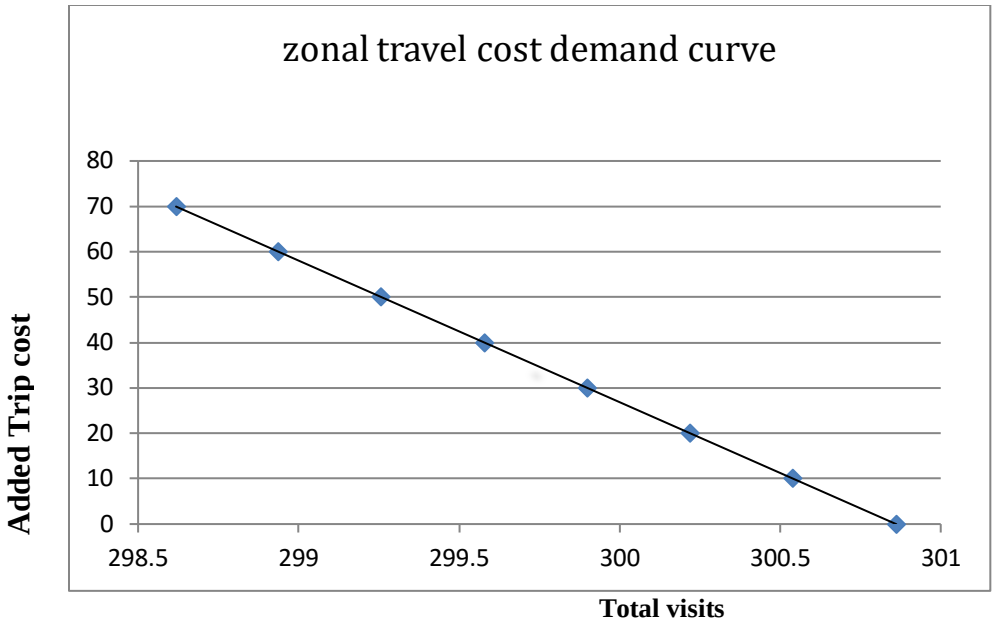

Figure 1: Demand curve for Log-linear

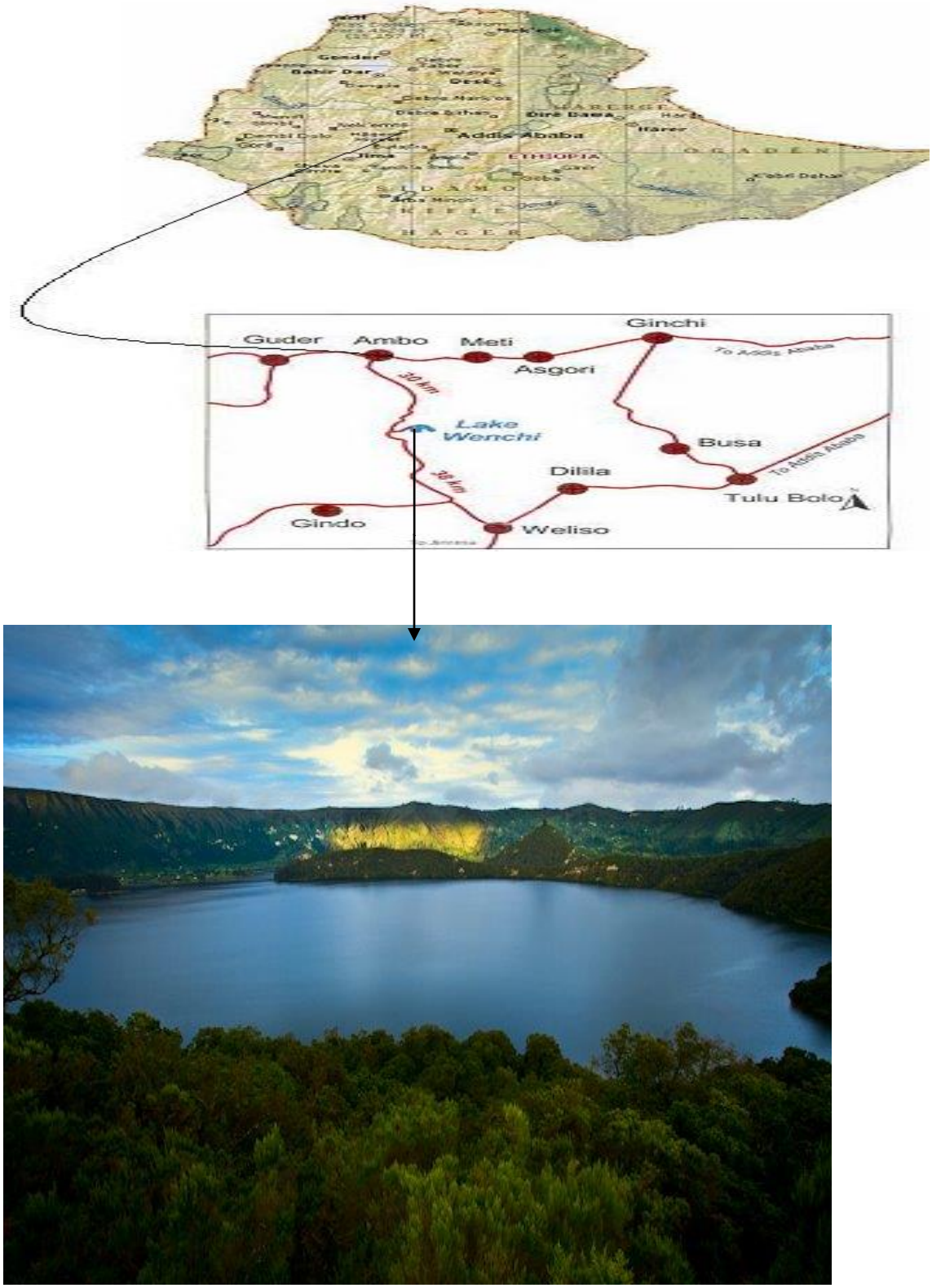

Figure 2: Location and picture of Wonchi Crater Lake in Ethiopia

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Figure 3: Topography of Wonchi Crater Lake [25]